Quantifying Event Location

Proposal to make the criteria for event location more objective.

This has become more important in Phase 2 since there is a significant number of events with low primary multiplicity.

One and two track vertices are **not** background free, nor are they **unambiguous**.

There are also a small number of emulsion vertices that do not seem to match spectrometer information.

We should quantify "matching" of emulsion to electronic data.

Useful Information

1. Probability of vertex being a background
   - 1.1 Random association
   - 1.2 Not associated with SFT info

2. Emulsion tracks matched to SFT tracks
   - 2.1 Number of matched tracks
   - 2.2 Probability of random matching
   - 2.3 Muon ID and match

3. Emulsion tracks matched to Calorimeter clusters
   - 3.1 Number of matched tracks
   - 3.2 Probability of random matching

DON'T USE CALORIMETER

Criteria

1.1 Tracks within 5 mm
1.2 Tracks angle < 300 mr

2.1 Emulsion - SFT angle $\sigma = 5\ \text{mr} \oplus \sigma_{MS}$,
where $\sigma_{MS} \equiv 14\left(\frac{\theta}{0.3}\right)\sqrt{x}\ mrad$

2.2 Muon ID hits ≥ 4

~~3.1 Emulsion - Ecal position @ Ecal $\sigma = 5$ cm~~
3.2 Ecal cluster $E_{clus} > 10$ GeV

Implementation

1.1 Need densities of stopping tracks in location volume

1.2 Need densities of random vertices in location volume

2.1 Determine $\Delta\theta^{sig}_{SFT}/\sigma$ for all emulsion tracks

2.2 Randomly rotate emulsion tracks in ϕ, find $\Delta\theta^{bkg}_{SFT}/\sigma$

~~3.1 Determine $\Delta r^{sig}_{SFT}/\sigma$~~

~~3.2 Randomly rotate emulsion tracks in ϕ, find $\Delta r^{bkg}_{SFT}/\sigma$~~

Find "Total" sig/bkg from $1 \oplus 2 \oplus$ ~~3~~ ;
(weighted with significance?)

Remarks:

- One-track vertices are likely to have ambiguous solutions

  • information available :
    - angular match discrimination
    - momentum match (sometimes)

  • Systematic effects:
    - incorrect z positions
    - Distorted p_{μ} spectrum

- Two-track vertices can have significant background

  • Ambiguity probability small

  • Background significant if :
    - SFT busy
    - no momentum information
    - vertex within high-density region of module